Discounted Present Value, Inflation Accounting, and Special Economic Topics

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Overview

- ***Discounting***
- ***Inflation Accounting***
  - **Inflation Indices**
  - **Basic Price Indices**
  - **Commodities**
  - **Outlays & TOA**
  - **Revisions to Inflation Assumptions**
- ***Making Budgets Using Deflators***
- ***Special Economic Topics***
  - **Pricing DoD Military & Civilian Pay**
  - **Pricing DoD's Nonpay Purchases**
    - **Transition, Fixed to Chain-weight GDP Deflator**

Discounted Present Value (DPV)

Compare program alternatives when costs and benefits are distributed over time

Opportunity Cost of Capital

- ***Money today***
  is worth more than money tomorrow

- ***cost of diverting funds from the next most attractive project ("opportunity cost") influences discount rate***
  (higher opportunity cost higher discount rate)

Discounted Present Value

Sum of the discounted values of current and future costs and benefits

DPV Example

- ***Two alternatives***
  - ***Status quo operational system***
  - ***Alternative (system modification)***

	FY 1998	FY 1999	FY 2000	FY98-00
Status Quo				
Investment Cost	0.0	0.0	0.0	
Operational Cost = SQop_cost	200.0	210.0	220.0	
Total, not discounted	200.0	210.0	220.0	630.0
Alternative offering --				
40% Reduction in Operating Costs				
Investment Cost	150.0	0.0	0.0	
Promised Reduction=0.4*SQop_cost	0	-84.0	-88.0	
Net Operating Cost	200.0	126.0	132.0	
Total, not discounted	350.0	126.0	132.0	608.0

Alternative is less expensive than the Status Quo

Using the Discount Rate

- ***Then-year $ discount rate = 6%***

	FY 1998	FY 1999	FY 2000	FY98-00
Discount @ 6%				
DPVweights = $1/1.06^0$, $1/1.06^1$, $1/(1.06)^2$, etc.	1.0000	0.9434	0.8900	
DISCOUNTING @ 6%				
status quo x DPVw =	200.0	198.1	195.8	593.9
alt. NET operating cost x DPVw =	200.0	118.9	117.5	
alt. Investment cost x DPVw =	150.0	0.0	0.0	
Total cost for alt., discounted =	350.0	118.9	117.5	586.3

Alternative is *still* less expensive than the Status Quo

Representing Risk by Using a High Discount Rate

- ***NOT** permitted by OMB.*
- ***CASE CLOSED**.*

DPV and Treatment of Risk

- ***Government: Must use T-bond interest rates***
  - ***Reflects U.S. Government cost of capital***
  - ***Prevents program advocates from using discount rates to influence DPV calculations***

Add RISK to the Example

- ***Weight*** *outcomes by the* ***probability*** *of occurrence (a la OMB Circular A-94, 9b).*

*** suspect only a 60% likelihood that the alternative
*** provides the 40% reduction in Operational Costs

EXPECTED VALUE of Alternative

	FY 1998	FY 1999	FY 2000	FY98-00
Status Quo Operational Cost	200.0	210.0	220.0	
Promised Reduction = 0.4 x SQOC	0.0	-84.0	-88.0	
E.V. of Promised Reduction = 0.6 x PR	0.0	-50.4	-52.8	
Investment Cost	150.0	0.0	0.0	
Total E.V. of Alt., not discounted	350.0	159.6	167.2	676.8
DPV of Discounted Alt. Total	350.0	150.6	148.8	649.4
SQ Total, not discounted	200.0	210.0	220.0	630.0
DPV of Discounted SQ Total	200.0	198.1	195.8	593.9

Status Quo is now less expensive than the Alternative!

Considerations for Using DPV

- ***Duration of program***
  - *OMB discount rates depend on duration (3 to 30 years)*
  - *(Long-term interest rates usually exceed short-term)*

- ***Data in then-year $, or constant $***
  - *OMB specifies then-year $ and constant $ discount rates*
  - *Discount rates are <u>not</u> inflation rates!*

A-94-Specified Discount Rates (will be revised March 1998)

	3-year	5-year	7-year	10-year	30-year
Nominal (then-year $)	5.8%	5.9%	6.0%	6.1%	6.3%
Inflation rate = 2.6%					
Real (constant $)	3.2%	3.3%	3.4%	3.5%	3.6%

Further Comments on Risk

- *Exactly **WHAT** is uncertain?*
- *Probabilities for Expected Value:*
  - ***Which** probabilities to apply?*
  - *Should the probabilities be **constant** over time?*

Inflation Accounting

- *Inflation Indices*
- *Basic Price Indices*
- *Commodities*
- *Outlays & TOA*
- *Revisions to Inflation Assumptions*

Frequently Requested Inflation Calculations

- *Current Dollars to Constant Dollars*
- *Constant Dollars to Current Dollars*
- *TOA to Outlays*
- *Changing from one set of inflation assumptions to another*

Inflation is . . .

* *Change in the price of goods and services --*
* *Quantity and Quality remain constant.*

Inflation Projections

- *OMB's guidance DoD Inflation Projections.*
- *OMB gives DoD its top line (then-year $).*

(OMB sets the rules.)

Basic Price Indices

- *FY00 Index = FY99 Index □ (1+FY00 y-to-y rate)*
- *FY98 Index = FY99 Index Z (1+FY99 y-to-y rate)*

	FY1998	FY1999	FY2000
Price Increase over prior year	1.4%	1.5%	1.6%
= year-to-year rate	0.014	0.015	0.016
Price Index: base year = 1999	0.9852	1.0000	1.0160

=1.000/(1+0.015)

=1.000(1+0.016)*

Current and Constant Dollars

- ***Constant**: prices as of a given date*
- ***Current** (or then-year, or nominal): **prices prevailing at the time of expenditure***

	FY1998	FY1999	FY2000
Price in 1999 Dollars	$ 100.00	$ 100.00	$ 100.00
x Price Index *(FY99 Base Year)*	*0.9852*	*1.0000*	*1.0160*
= Then-year Price Forecast	$ 98.52	$ 100.00	$ 101.60

Re-Basing a Price Index

- *"Constant Dollars" needed for an**other** base year*
- *So: **re-base** the price index **to 1.00** in the **other** year.*

	FY1998	FY1999	FY2000
PRICE in FY99 Dollars	**$ 100.00**	**$ 100.00**	**$ 100.00**
Price Index, FY98 Base	**1.0000**	**1.0210**	**1.0424**
Price Index, FY99 Base	**0.9852**	**1.0000**	**1.0160**
by(PI, FY98 base / PI, FY99base)			
for FY1998	**(1.000/0.9852)**		
= PRICE in FY98 Dollars	**$98.52**	**$98.52**	**$98.52**

Commodities and Inflation Assumptions

- *Every item in DoD's budget is a linear combination of*
  - *Military Pay*
  - *Civilian Pay*
  - *Fuel*
  - *Other Purchases*
- *Each "commodity" is associated with a separate inflation assumption.*

Inflation Assumptions for DoD, FY 1998 President's Budget

	Percentage Increase over Prior Year (Outlays)							
	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04
Military Pay (from Jan. 1)	3.0	2.8	3.0	3.0	3.0	3.0	3.0	3.0
Civilian Pay (from Jan. 1)	3.0	2.8	2.0	2.0	2.0	2.0	2.0	2.0
Fuel	1.3	19.7	-4.4	2.6	2.6	2.6	2.6	2.6
Other Purchases	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.6

Source: PDUSD(Comptroller) Memorandum, "Revised Inflation Guidance," January 7, 1997

Inflation Assumptions for DoD, FY 1999 President's Budget

	Percentage Increase over Prior Year (Outlays)						
	FY98	FY99	FY00	FY01	FY02	FY03	FY04
Military Pay (from Jan. 1)	2.8	3.1	3.0	3.0	3.0	3.0	3.0
Civilian Pay (from Jan. 1)	2.8	3.1	3.0	3.0	3.0	3.0	3.0
Fuel	19.7	-8.8	2.1	2.1	2.1	2.1	2.1
Other Purchases	1.4	1.5	1.6	1.7	1.7	1.7	2.2

Source: USD(Comptroller) Memorandum, "Revised Inflation Guidance," December 23, 1997

Combination of Commodities in DoD Programs

- *Many DoD appropriations combine two or more commodities*
  - *MilPers = Military pay + "Other purchases" for (e.g.) moving expenses*
  - *O&M = Civilian pay + Fuel + "Other Purchases"*
  - *Procurement = 100% "Other Purchases"*
- *Programs with more than one commodity have a composite, weighted average, price index.*

A Weighted Average Price Index

- *A weighted price index can be calculated for a program, or for an appropriation*

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Program Cost, $M, FY99 Prices:							
Civilian Pay	**10.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**	**15.00**
Other Purchases	**10.00**	**20.00**	**25.00**	**25.00**	**25.00**	**25.00**	**25.00**
Total	**20.00**	**35.00**	**40.00**	**40.00**	**40.00**	**40.00**	**40.00**
Civilian Pay Price Index	***0.9706***	***1.0000***	***1.0303***	***1.0612***	***1.0930***	***1.1258***	***1.1596***
Other Purchases Price Index	***0.9862***	***1.0000***	***1.0160***	***1.0333***	***1.0508***	***1.0687***	***1.0922***
Program Cost in Then-year Prices							
Civilian Pay	**9.71**	**15.00**	**15.45**	**15.92**	**16.39**	**16.89**	**17.39**
Other Purchases	**9.86**	**20.00**	**25.40**	**25.83**	**26.27**	**26.72**	**27.31**
Total	**19.57**	**35.00**	**40.85**	**41.75**	**42.67**	**43.60**	**44.70**
Program Weighted Price Index	***0.9784***	***1.0000***	***1.0213***	***1.0437***	***1.0666***	***1.0901***	***1.1175***

Outlays, and Total Obligational Authority (TOA)

- *DoD programs typically take several years to carry out*
- *Congress and OMB prohibit "incremental funding." TOA (or Budget Authority) is to be spent during, or after, the year of appropriation*
- *Pay and fuel funding are assumed to be spent 100% in the year of appropriation*
- *"Other Purchases" funds have an outlay pattern over several years*

Spendout of TOA into Outlays

Example of "Other purchases" TOA:

Other Procurement, Army

spendout profile:	1st year	2nd year	3rd year	4th year	5th year	6th year
	19.0%	42.0%	26.2%	4.0%	3.5%	5.3%

Example of TOA Spendout into Outlays:

spendout profile x TOA

	FY98	FY99	FY00	FY01	FY02	FY03	FY04
TOA	100	50	0	0	0	0	0
Outlays from FY98 TOA B	19.00	42.00	26.20	4.00	3.50	5.30	0
Outlays from FY99 TOA	0	9.50	21.00	13.10	2.00	1.75	2.65
Outlays Total	19.0	51.5	47.2	17.1	5.5	7.1	2.65

Outlay and TOA Price Indices

When prices (are forecast to) rise over time, a TOA price index is higher than an Outlays price index

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Other Procurement, Army, Spendout Profile	**19.0%**	**42.0%**	**26.2%**	**4.0%**	**3.5%**	**5.3%**

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Other Purchases Price Index (Outlays), FY99 base	***0.9862***	***1.0000***	***1.0160***	***1.0333***	***1.0508***	***1.0687***	***1.0922***
Other Purchases Price Index (TOA), FY99 base, for Other Procurement, Army	***1.0083***	***1.0248***	***1.0425***	***1.0609***	***1.0810***	***1.1038***	***1.1281***

TOA Constant Dollars: "Pure," and "Constant Budget"

- *An FY99 TOA price index typically is not 1.000 in FY 1999*
  - *but reflects the same prices as the outlay price index*
- *The "Constant Budget Dollar" TOA index is normalized to 1.000 in the base year.*

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
TOA "Pure Constant Dollar" Price Index, FY99 Base	*1.0083*	*1.0248*	*1.0425*	*1.0609*	*1.0810*	*1.1038*	*1.1281*
TOA "Constant Budget Dollar" Price Index, FY99 Base	*0.9840*	*1.0000*	*1.0173*	*1.0353*	*1.0549*	*1.0772*	*1.1009*
Then-Year TOA	**$10,000**	**$10,000**	**$10,000**	**$10,000**	**$10,000**	**$10,000**	**$10,000**
TOA in FY99 Pure Constant Dollars	**$9,917**	**$9,758**	**$9,593**	**$9,426**	**$9,250**	**$9,059**	**$8,864**
Constant Budget Dollars	**$10,163**	**$10,000**	**$9,830**	**$9,659**	**$9,479**	**$9,284**	**$9,084**

Comparing Dollar Figures form Different Budgets

- *Compare "real" purchasing power from different years' documents.*
- *Inflation Assumptions changed (twice!) between FY96 and FY98 PBs.*
- *How do you compare the numbers properly?*

	Procurement TOA, $ Billion					
	FY85	FY97	FY98	FY99	FY00	FY01
FY98PB - Current $	90.0	44.3	42.6	50.7	57.0	60.7
FY96PB - Current $	90.0	43.5	51.4	54.2	62.3	67.3
----CBD----						
FY98PB - FY98 Con.Bud. $	127.0	45.2	42.6	49.7	54.6	56.9
FY96PB - FY96 Con.Bud. $	126.2	42.2	48.5	49.6	55.3	58.0

Making Two Budgets' Dollar Figures Commensurate -- 1

- ***Choose*** *one data set to re-price (e.g. FY96 into FY98)*
- ***"Back out"*** *FY96 budget economic assumptions*
  - *where different from FY98 assumptions*
- ***"Reflate"*** *using FY98 budget assumptions*
- *See OUSD(C)* ***Green Book****, the "National Defense Budget Estimates for FYxx"*

Making Two Budgets' Dollar Figures Commensurate -- 2

	FY98	FY97	*FY96*	…FY92…	FY88	FY87	FY86
FY**96** Budget							
Proc TOA Index	1.0609	1.0300	1.0000	0.8953	0.7917	***0.7625***	0.7365
Annual Change	3.00%	3.00%	3.00%	2.53%	3.83%	**3.53%**	3.21%
FY**98** Budget							
Proc TOA Index	1.0000	0.9794	0.9592	0.8846	0.7861	***0.7568***	0.7311
Annual Change	2.10%	2.11%	2.08%	2.29%	3.87%	**3.52%**	3.18%

- *Find when annual changes are the same, FY87*
- *Then back out FY96 assumptions:*

$48.5B CBD

	FY85	FY97	FY98	FY99	FY00	FY01
Deflate FY96 PB to FY87$, * **FY96 *index***	96.2	32.2	37.0	37.8	42.2	44.2
Reflate from FY87$ to FY98$, / **FY98 *index***	**127.1**	**42.5**	**48.9**	**50.0**	**55.7**	**58.4**

CBD

Making Two Budgets' Dollar Figures Commensurate -- 3

The Right Answer! Procurement TOA, $ Billion

	FY85	FY97	FY98	FY99	FY00	FY01
FY98 PB in FY98 Con.Bud $	127.0	45.2	42.6	49.7	54.6	56.9
FY96 PB in FY98 Con.Bud $	127.1	42.5	48.9	50.0	55.7	58.4
Difference	-0.1	+2.7	-6.3	-0.4	-1.1	-1.6

DO NOT *EVEN DREAM OF*

- *Dividing FY96$ by FY96 index from FY98 budget,* ***OR***
- *Multiplying FY96$ by FY98 index from FY96 budget.*

Making Budgets Using Deflators

"In real purchasing power, the FY 1999-2003 FYDP will buy more defense than previously planned because President Clinton allowed the Department to keep about $20 billion in savings projected from lower estimates of future inflation."

Department of Defense Budget for FY 1999

News Release, February 2, 1998, OASD(Public Affairs)

Special Economic Topics

- *Pricing DoD Military & Civilian Pay*
- *Pricing DoD's Nonpay Purchases*
- *Transition from Fixed to Chain-weight GDP Deflator*

DoD Pay

- ***DoD Pay Ψ $100B/year***
- ***Escalation in DoD pay is based on changes in the private sector ECI for wages & salaries***
- *ECI = Employment Cost Index*

Annual DoD Pay Escalation

- **Military**
  - *ECI - 0.5%*
- **Civilian (for "outyears")**
  - *before FY99 PB was ECI - 1.5%*
  - *for FY99 PB is ECI - 0.5%*

ECI is Composed of

WAGES & SALARIES component

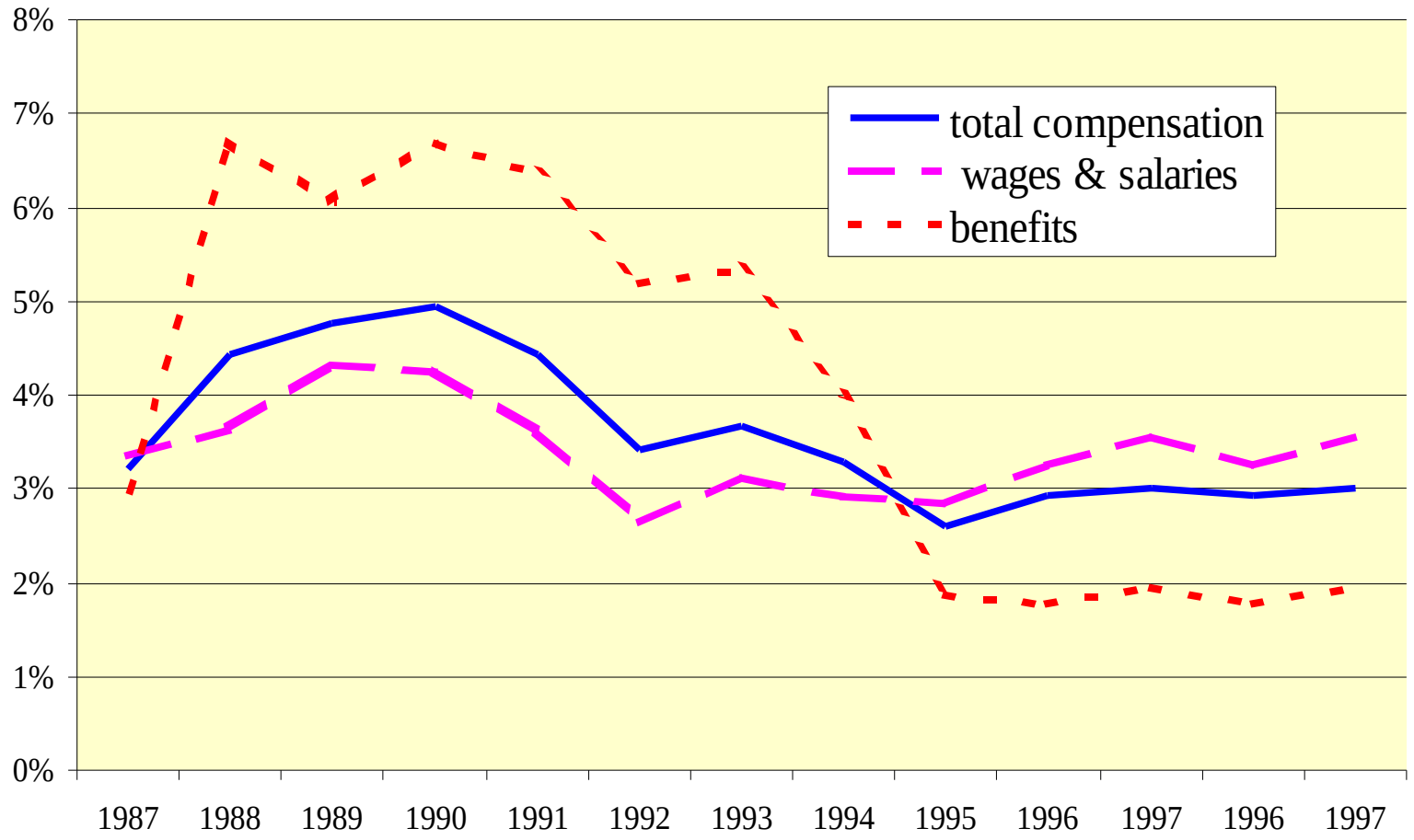
+

BENEFITS component

- **In the 1980s and early 1990s the <u>benefits</u> escalated at a higher rate than <u>wages & salaries</u>**

And Now . . .

Annual Changes in ECI, Private Industry



Other Purchases

Fixed-Weight

GDP Deflator

--TO --

Chain-Weight

GDP Deflator

***(Chain about 0.5% higher than fixed in* December 1995)**

- ***OMB/DoD agreement***

Most Recent Projections

	OMB- **DoD***	*fixed* ***WEFA***	chain **WEFA**	chain **DRI**
FY97	***1.8***	*2.4*	2.1	2.1
FY98	***1.4***	*2.2*	2.0	1.9
FY99	***1.5***	*2.5*	2.5	1.8
FY00	***1.6***	*2.7*	2.5	1.8
FY01	***1.7***	*2.6*	2.5	1.8
FY02	***1.7***	*2.6*	2.5	2.0
FY03	***1.7***	*2.8*	2.7	---
FY04	2.2	---	2.7	---

* OMB specified that, through FY03, DoD's deflator for nonpay purchases is the chain weight deflator minus 0.5% (December 1995).

Where to Go for More Information

- *Army*
  - *asafm-www.army.pentagon.mil/CEAC.htm* *POC Mr. Larry Stopher (703) 697-6241*
- *Navy*
  - *http://www.ncca.navy.mil* *POC Mr. Harold Dagel (703) 604-0314*
- *Air Force*
  - *http://www.saffm.hq.af.mil/SAFFM* *POC Mr. Steve Connair (703) 695-5076*
- *BLS (GDP deflator, ECI)*
  - *http://stats.bls.gov*
- *National Defense Budget Estimates for FY XXXX (Green Book)*
  - *http://www.dtic.mil/comptroller/topics.html*
- *The New Palgrave: A Dictionary of Economics, 1987.*

Additional Reading

- *Present Discounted Value*
  - *Fisher, Gene H., Cost Considerations in Systems Analysis, Rand R-490-ASD, December 1970.*
  - *"Capital Budgeting," The New Palgrave: A Dictionary of Economics, vol. 1, pp. 341-2, 1987.*
  - *Executive Branch use regulated by OMB Circular A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs"*
    - *Current version at www.whitehouse.gov/WH/EOP/omb, or call (202) 395-3381*
- *Inflation Assumptions*
  - *Preview of the Comprehensive Revision of the National Income and Product Accounts: BEA's New Featured Measures of Output and Prices (Survey of Current Business, July 1995, 31-38.)*